MASTER OF SCIENCE
IN
METEOROLOGY AND PHYSICAL OCEANOGRAPHY

IMPACT OF HIGH RESOLUTION WIND FIELDS ON COASTAL OCEAN MODELS

David Guy Blencoe-Lieutenant, United States Navy
B.S., University of South Carolina, 1994
Master of Science in Meteorology and Physical Oceanography-September 2001
Advisor: Jeff Paduan, Department of Oceanography
Second Reader: Curt Collins, Department of Oceanography

The development of a coastal ocean circulation model involves many challenges, including the interaction of complex coastline and topography and the prediction of mesoscale oceanographic features. The Innovative Coastal-Ocean Observing Network (ICON) developed a Monterey Bay ocean circulation model to resolve these challenges. This study examines two different ICON model cases. The first ICON model case was forced with the 100 km NOGAPS winds while the other was forced with the 9 km COAMPS winds. The comparison demonstrated that the 9 km COAMPS-forced case produced better resolution of the ocean mesoscale. This was shown through examination of the daily sea surface temperature fields and the daily surface ocean currents. Time series of sea surface temperature showed a strong seasonal cycle. After removal of the seasonal cycle, the existence of mesoscale features was even more dramatic. A case study at Pt. Sur showed the evolution of mesoscale features associated with an upwelling event.

PARAMETERIZING SURFACE FLUXES IN THE ARCTIC

Anna C. Bryant-Lieutenant, United States Navy
B.S., University of South Carolina, 1996
Master of Science in Meteorology and Physical Oceanography-September 2001
Advisor: Peter Guest, Department of Meteorology
Second Reader: Qing Wang, Department of Meteorology

There is a need for computationally efficient methods to determine surface radiation in the Arctic based on surface parameters such as cloud presence, sun angle, temperature and other easily measured variables. This study uses data from the SHEBA project to verify simple radiation parameterizations and to compare with other locations. Skies during SHEBA were usually either totally clear or totally overcast, with low clouds predominating, especially in the non-winter seasons. This resulted in large changes in radiation every time the cloud coverage changed.

There was a large range in the skill of the parametric equations. The most accurate equations had average total errors of 9 Wm -2 , 14 Wm -2 , 22 Wm -2 and 59 Wm -2 for downwelling longwave in clear skies, cloudy skies, shortwave clear and cloudy skies respectively. Compared to the Weddell Sea (Antarctic) the average downward longwave radiation was greater for all sky conditions. Shortwave values were comparable to the Weddell Sea, although there was large variability.

MINE DROP EXPERIMENT (MIDEX)

Anthony Gilless-Lieutenant, United States Navy
B.S., United States Naval Academy, 1993
Master of Science in Meteorology and Physical Oceanography-September 2001
Advisor: Peter Chu, Department of Oceanography
Second Reader: Peter Fleischer, Naval Oceanographic Office - Stennis Space Center

The Navy's Impact Burial Prediction Model (IMPACT 25) determines the amount of burial a mine experiences upon impacting the marine sediment. Impact burial calculations are derived primarily from the sediment characteristics and from the mine's two-dimensional air and water phase trajectories. Accurate burial prediction requires that the model's air and water phase trajectories reasonably mimic the objects true trajectory. IMPACT 25 assumes that the objects are cylindrical in shape and calculates the air and water phase trajectories entirely from momentum equations.

In order to determine what effect a varying center of mass has on a mine's water phase trajectory, a Mine Drop Experiment was conducted. The experiment consisted of dropping three cylinders of various lengths into a pool where the trajectories were filmed from two angles. The controlled parameters were, the ratio of mine length to diameter, initial velocity, center of mass position and drop angle. Results indicate that center of mass position has the largest influence on the object's trajectory and that accurate trajectory modeling requires the inclusion of both momentum and moment equations.

CLASSIFICATION OF SUMMERTIME WEST COAST FOG AND STRATUS EVENTS AND THE DEVELOPMENT OF FOG AND STRATUS FORECAST TECHNIQUES

Greg S. Ireton-Lieutenant, United States Navy
B.S., University of North Carolina, Asheville, 1997
Master of Science in Meteorology and Physical Oceanography-September 2001
Advisor: Wendell A. Nuss, Department of Meteorology
Second Reader: Douglas K. Miller, Department of Meteorology

The fog and stratus that frequently plagues the West Coast in the summer months is responsible for a variety of impacts on everyday life, the greatest being on aviation. Many flight delays and cancellations that are experienced around the Pacific Rim are attributed to the development and evolution of the fog and stratus on the U.S. West Coast. This thesis studies the evolution of the fog and stratus events during the summer of 2000 through the use of geostationary, GOES-10, visual satellite imagery to develop a classification scheme. The synoptic-scale weather patterns as well as the mesoscale coastal regime were then associated with a type of stratus evolution. The Navy's mesoscale model, coupled ocean/atmosphere mesoscale prediction system (COAMPS), provided detailed simulation of 11 events to highlight the boundary layer evolution and its relationship to fog and stratus evolution. The fog and stratus classification scheme produced several consistent synoptic and mesoscale signals associated with stratus evolution. These relationships provide some forecasting techniques that should aid forecasters with predicting the evolution of fog and status events.

A COASTAL AIR-OCEAN COUPLED SYSTEM FOR THE EAST ASIAN MARGINAL SEAS

Michael J. Roth-Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1992
Master of Science in Meteorology and Physical Oceanography-September 2001
Advisor: Peter C. Chu, Department of Oceanography
Second Reader: Steven D. Haeger, Naval Oceanographic Office - Stennis Space Center

A coastal air-ocean coupled system (CAOCS) that includes the Princeton Ocean Model (POM) as the oceanic component and the Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Model Fifth Generation (MM5) as the atmospheric component was developed for the East Asian Marginal Seas (EAMS) – a littoral environment that is a common operating area for the

United States Navy (USN). CAOCS output verified against surface wind data from the National Centers for Environmental Prediction (NCEP) and sea surface temperature (SST)/Sea Surface Salinity (SSS) data collected from buoy stations. CAOCS output clearly shows the significance of atmospheric and oceanic mesoscale features and their associated air-sea interaction processes such as coastal upwelling, Ekman transport, and enhancement of upward vertical motion during cyclogenesis. These mesoscale features and air-sea interaction processes occur during periods prior to summer monsoon onset as well as during time periods following summer monsoon onset.

The study provides support that CAOCS does perform well in forecasting EAMS surface current circulation, SST/SSS structure, surface wind stress, and low-level atmospheric structure. Some weaknesses of CAOCS were identified that will aid in future improvement of the model.

A NONLINEAR WAVE SHOALING MODEL FOR ALONGSHORE VARYING BATHYMETRY

David M. Ruth-Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1991
Master of Science in Meteorology and Physical Oceanography-September 2001
Advisor: Thomas H.C. Herbers, Department of Oceanography
Second Reader: Edward B. Thornton, Department of Oceanography

This thesis proposes an improvement to present near-shore wave prediction models. Using weakly dispersive Boussinesq theory, the shoaling of directionally spread surface gravity waves over a beach with gentle gradients in the cross-shore and alongshore directions is examined. Following Herbers and Burton (1997), the governing fluid flow equations are expanded to third order and depth-integrated over the water column. A resulting amplitude evolution equation for a spectrum of waves is derived, which is the main result of this paper. New terms in the higher order result include effects due to alongshore bottom slope, higher order cross-shore depth variations, and non-linear quartet interactions. The linear terms in this equation are verified by analytical methods using linear finite depth theory. Example computations for a monochromatic wave train over a plane beach quantify some of the improvements of this result over the lower order model. Opportunities for further development and verification of this result are proposed, and recommendations for application of the result in its present form are outlined.

PASSIVE SONAR GEOACOUSTIC INVERSION TECHNIQUE IN SHALLOW WATER USING THE INVERSE BETA METHOD AGAINST SHIPS OF OPPORTUNITY

Robert W. Witzleb-Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1992
Master of Science in Meteorology and Physical Oceanography-September 2001
Advisors: James H. Wilson, Department of Oceanography
Robert H. Bourke, Emeritus Professor of Oceanography

Electronic Intelligence (ELINT) data and broadband acoustic data were obtained during the April 1999 Fleet Battle Experiment Echo (FBE-E) in the SOCAL OPAREA. The motion of a target of interest (TOI) was reconstructed by the correlation and subsequent fusion of these data sets. This fusion resulted in a series of passively obtained range and range rate estimates for the TOI. These values were combined with the observed acoustic normal mode interference pattern (bathtub) for the TOI in order to empirically quantify the waveguide invariant (beta). Independently, a propagation model (Kraken) was run with historical geoacoustic input parameters for the region to simulate the normal mode structure of the waveguide. Furthermore, range-dependent mode-specific quantities were extracted from the model and combined with the observed interference pattern in order to establish numerical approximations for the TOI range. Subsequently, target range results from the fused data were compared to the numerical model derived range estimates.